



Wireless Indoor Location Accuracy

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Public safety does not dispatch to a X/Y:

39° 41' 11.93" N Latitude
104° 58' 54.72" W Longitude
5M Point Radius Uncertainty

They dispatch to an address

Reverse Geocoding
Nearest Intersection

S Pennsylvania St & E Iowa Ave
Denver, CO

Reverse Geocoding
Address Range

1600-1650 S S Pennsylvania St
Denver, CO

Reverse Geocoding
Point Match

1615 S Pennsylvania St
Denver, CO 80210

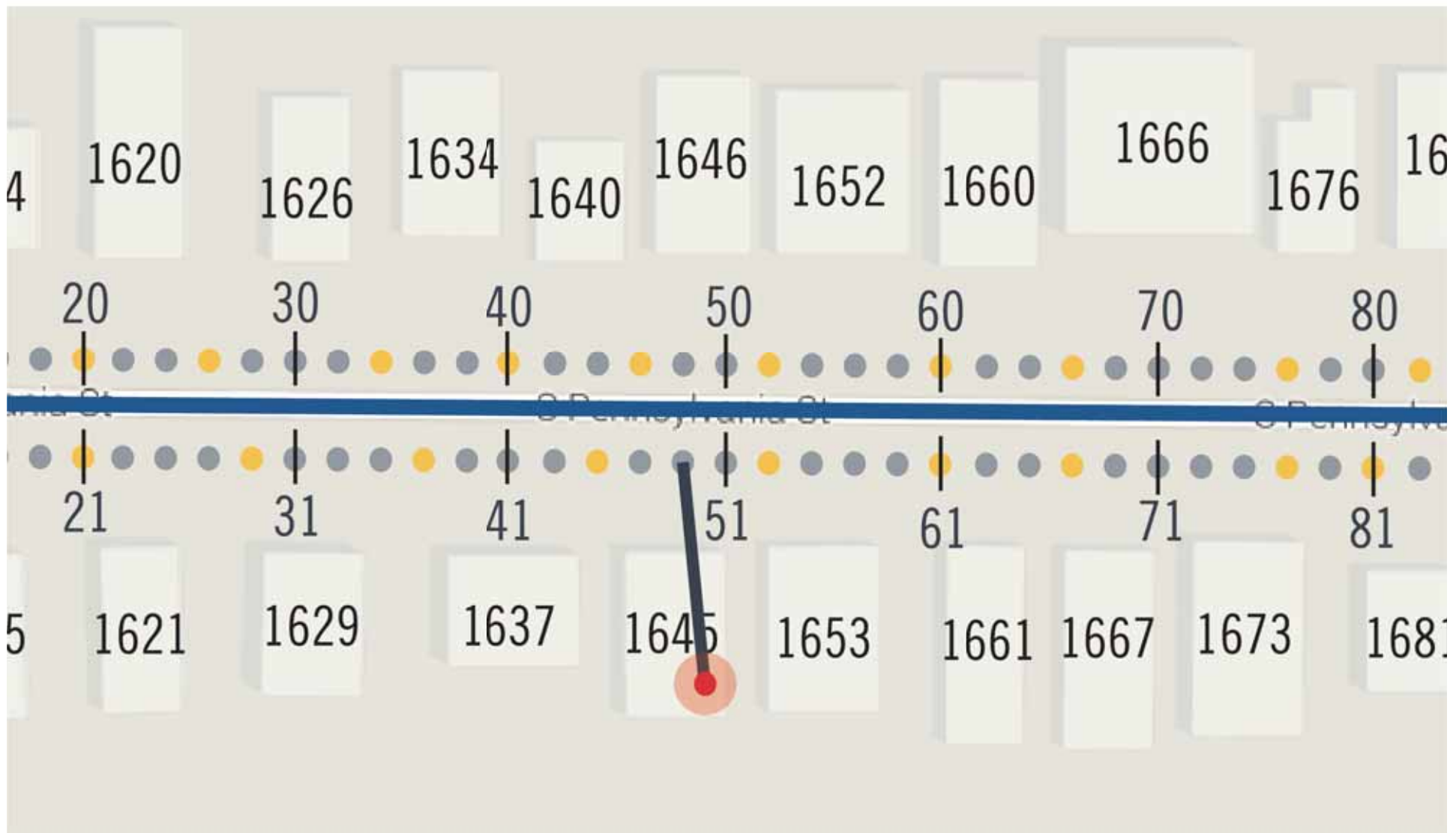
How is an address determined for a mobile call

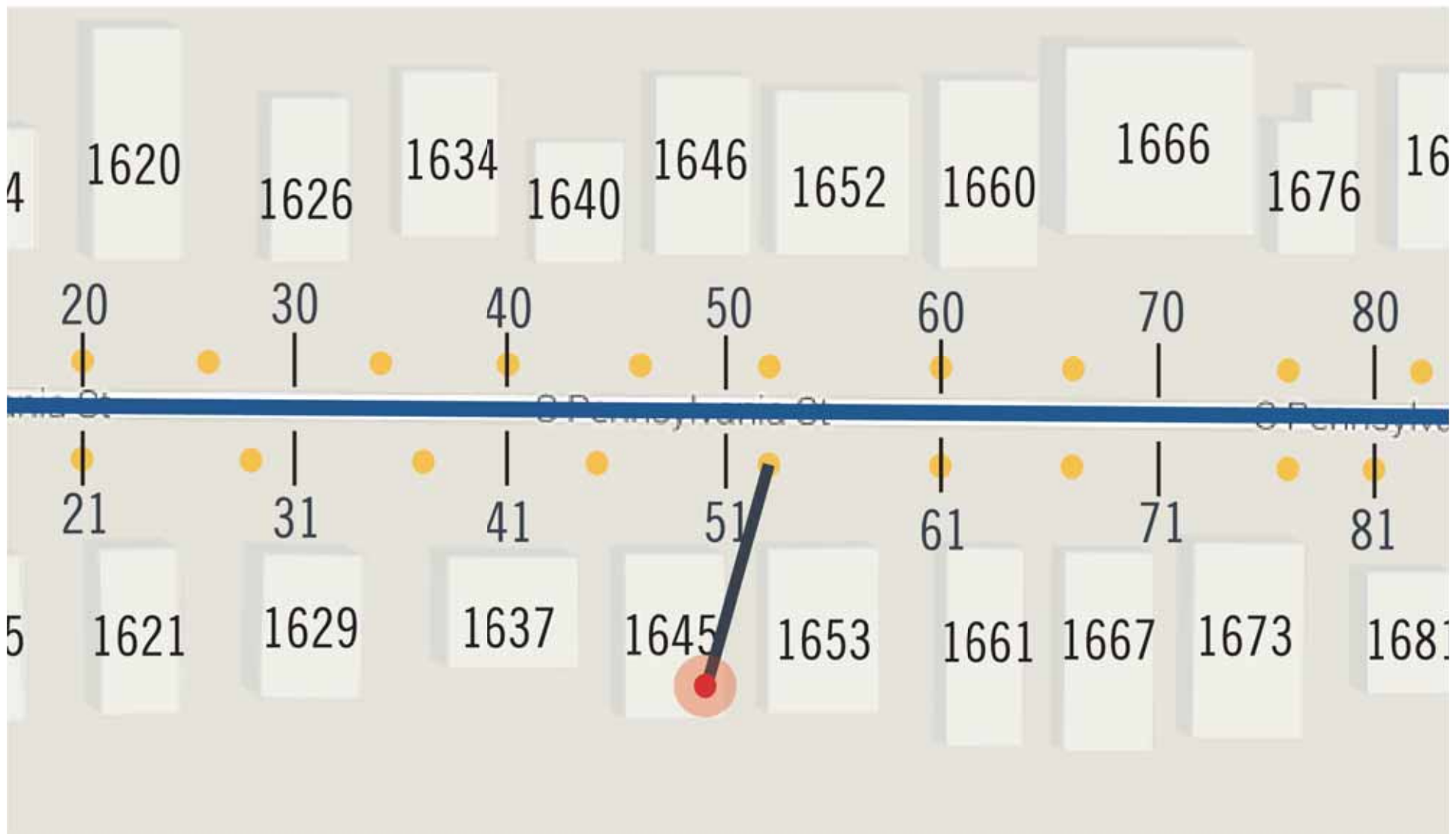
1. 9-1-1 call is placed by mobile subscriber
2. Mobile network starts location process
3. Proper PSAP is determined by Cell ID and call is routed to the proper PSAP
4. PSAP receives mobile 9-1-1 call and queries ALI for X/Y location
5. PSAP CPE receives X/Y location and passes it to CAD/MAPS
6. CAD/MAPS typically plots X/Y on screen and sometimes uncertainty area
7. CAD/MAPS typically provides telecommunicator an address through the process of reverse geocoding
 1. As a nearby intersection
 2. As an address range
 3. As a point address

Location Errors introduced because of Reverse Geocoding

- Reverse Geocoding is only as accurate as the base maps it utilizes
- Today base map data is generally not of sufficient resolution to provide reliable dispatchable addresses through reverse geocoding.
- Most PSAPs use local City/County base map data based upon street centerline data
- A few PSAPs are using better base map data but deployment is very slow and very expensive
- Reverse Geocoding is a “Best Guess” of the nearest address
- Even if the error on the mobile location is 0 feet, reverse geocoding typically adds 100’s or 1000’s of feet of error to the location
- Reverse Geocoded locations are less accurate than the X/Y they are derived from and create a perception that mobile location was less accurate than it actually was.







Reverse Geocoding Results – Case Study

Intrado conducted a study to determine the errors introduced through reverse geocoding from a large sample of simulated 9-1-1 calls made from the center of the primary structures at surveyed addresses. For these simulations, the uncertainty of the X/Y was 0 meters.

Results:

- Centerline Data – Typical county base map
 - Rural – 98% Of the time, wrong address was returned
 - Suburban – 98% Of the time, wrong address was returned
 - Urban – 79% Of the time, wrong address was returned
- Commercial Data – Best combined sources
 - Rural – 62% Of the time, wrong address was returned
 - Suburban – 63% Of the time, wrong address was returned
 - Urban – 15% Of the time, wrong address was returned

Dispatchable Address

- For Public Safety to effectively dispatch help to an emergency caller a dispatchable address is ultimately needed by the first responder to find the caller.
- Dispatchable Address – An address, in an acceptable format to public safety, that is of sufficient granularity to find the defined space the caller is within.
 - Example
 - Apartment 203, 123 Main street, Detroit, MI
 - 255 Fremont Blvd, Blacksburg, VA
 - Suite 200, 3345 decker Blvd., Seattle, WA

Determining a reliable Dispatchable Address

- Methods to help determine a reliable Dispatchable Address
 - Near Term (2014-2015) using systems and data available today
 - Femtocell - Residential
 - Femtocell - Enterprise
 - Geo-Relevant Wireless ALI
 - Mid Term (2015) using commercial App technology for 9-1-1 purposes
 - Commercial Bluetooth Low Energy Beacons
 - Commercial WiFi beacons
 - Long Term (2018) using new industry standards and software changes to handset
 - 9-1-1 Bluetooth Low Energy Beacons

Note: The time frames above reflect when the service could be made commercially available by wireless providers. It does not include the time that would be needed by wireless carriers to integrate the services within their network.

Improving X/Y/Z Location

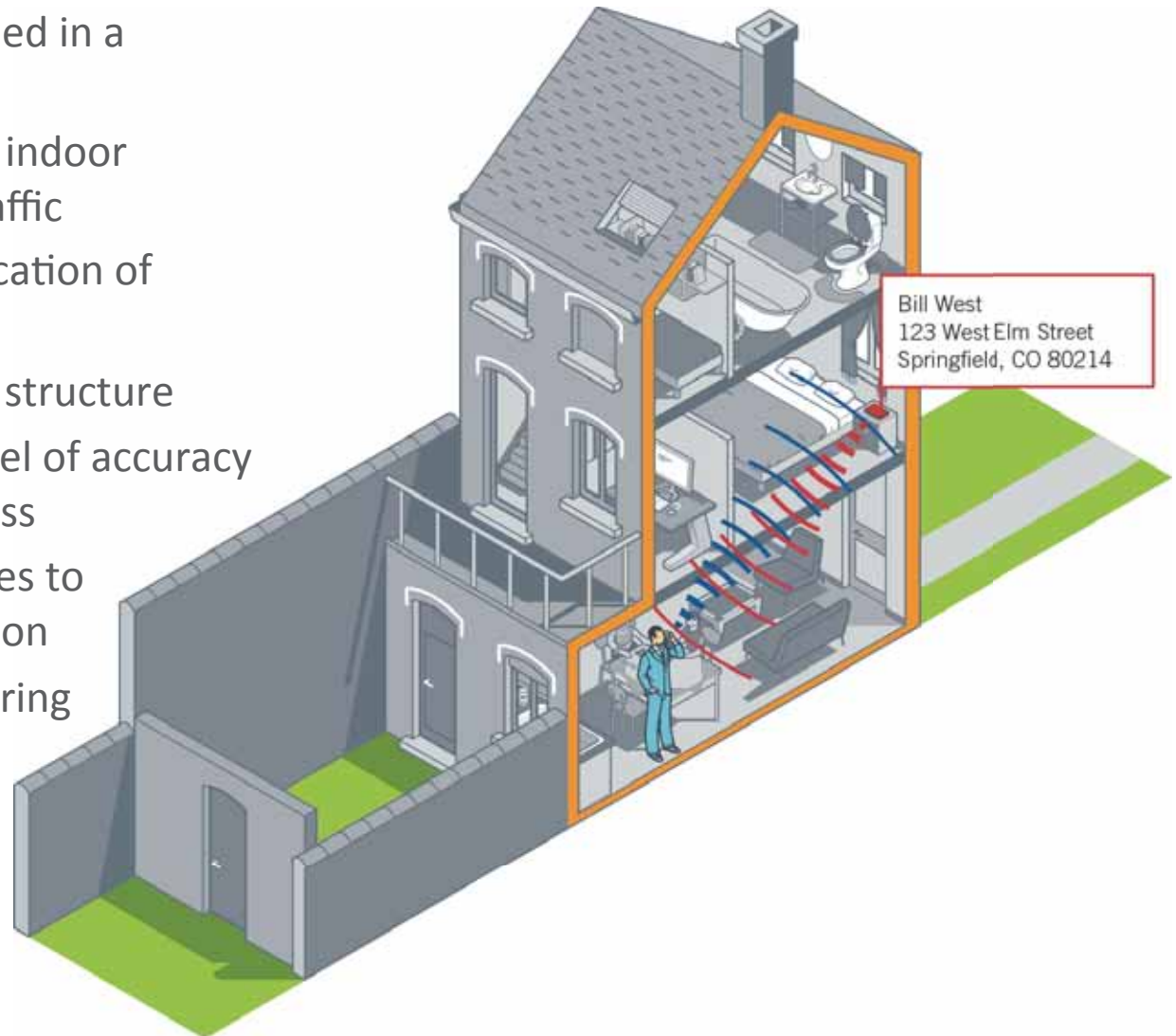
Improved accuracy of X/Y/Z increases the yield of dispatchable addresses and reduces the total error of reverse geocoding

- Methods to increase X/Y/Z accuracy
 - Mid Term (2015)
 - Commercial Handset Based Location
 - Apple, Android and Windows Location API
 - » GPS
 - » Cell ID
 - » WiFi Location
 - » Bluetooth Beacon
 - » Pressure Altitude (Z Coordinate)
 - Enterprise WiFi
 - Long Term (2018)
 - 9-1-1 Handset Based Location – using new industry standards and software changes to handset
 - Very Long Term (2020+)
 - New 9-1-1 Specific location Technologies requiring standards, hardware and handset hardware changes

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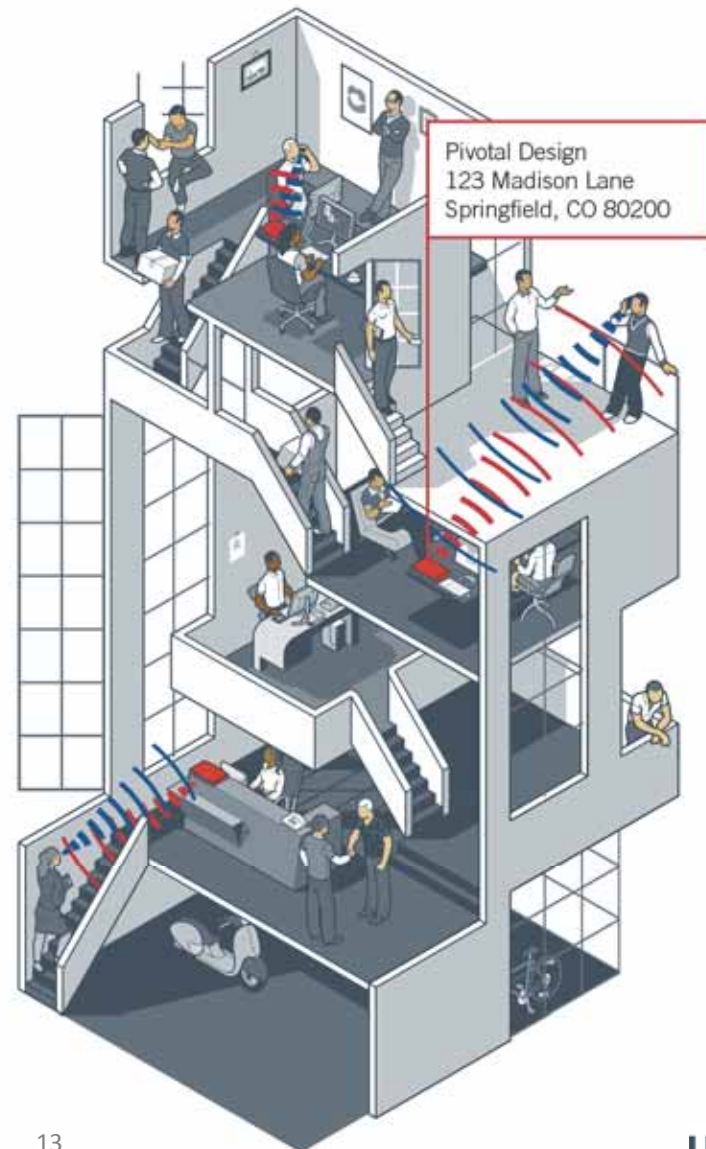
Residential Femto Cells

- Personal cell sites installed in a subscribers house
- Carrier offer to increase indoor coverage and offload traffic
- Contain GPS to verify location of device
- Typically cover inside of structure
- Can provide wireline level of accuracy with dispatchable address
- Requires delivery changes to utilize address information
- Some carriers are delivering address today



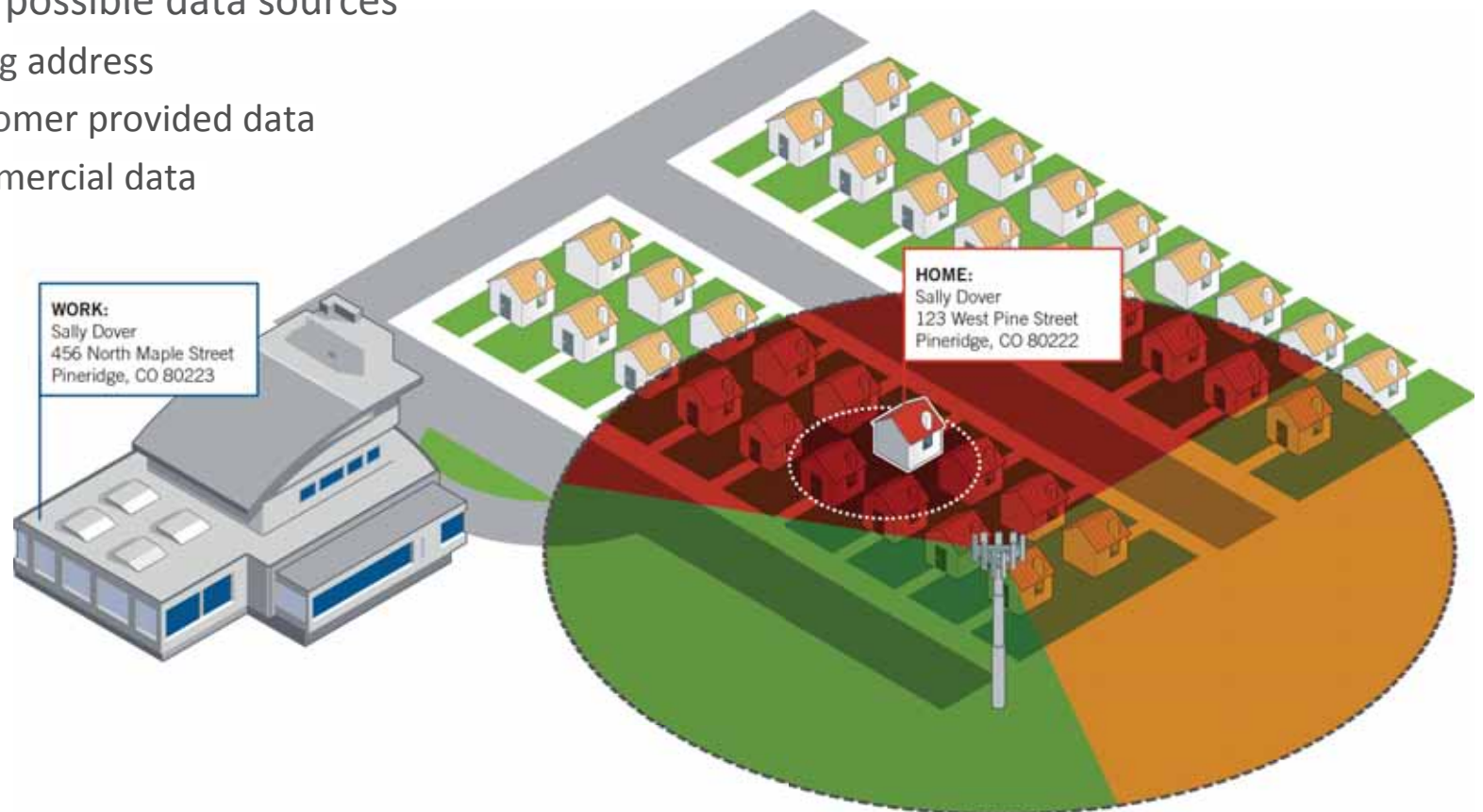
Enterprise Femto Cells

- Similar to Residential Femtocells but installed by Carrier or Enterprise and provides coverage to all users
- Carriers planning on deploying 100's of thousands for coverage and capacity
- Often cover definable indoor spaces
 - Offices
 - Public Spaces
- Can provide wireline level of accuracy with dispatchable address
- Requires delivery changes to utilize address information



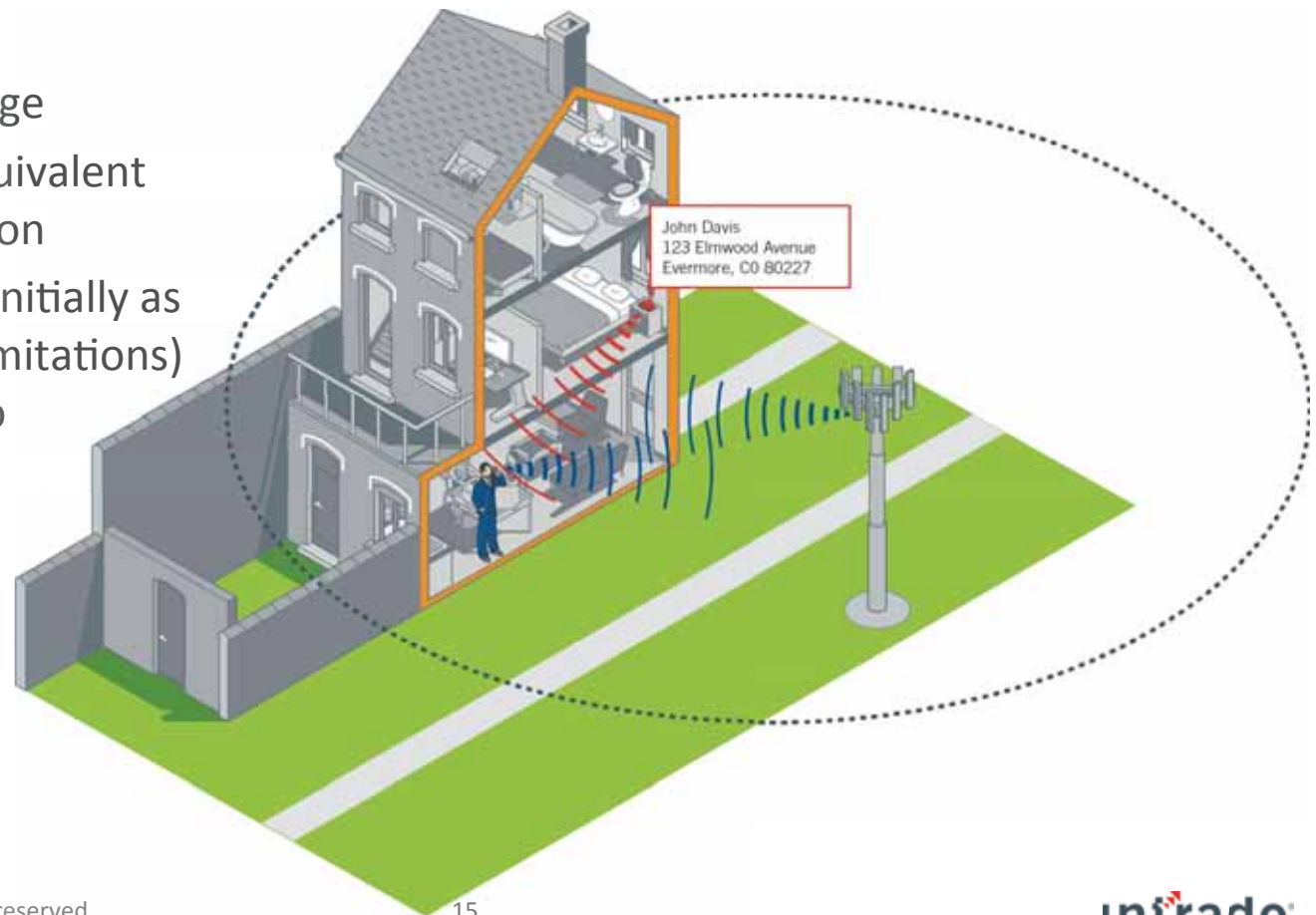
Geo-Relevant Wireless ALI

- Only provide addresses associated with emergency caller
- Associated user addresses are cross referenced with 9-1-1 location.
- Multiple possible data sources
 - Billing address
 - Customer provided data
 - Commercial data



Beacons

- Bluetooth Low Energy and WiFi
- Developed for commercial applications
- Integrated into Apple iOS and Android
- Very low cost
- Very low power usage
- Provide wireline equivalent 9-1-1 address location
- Could be deployed initially as application (with limitations) then integrated into handset through standards.



Z coordinate

- Many smart phones today are being shipped with accurate barometric pressure sensors installed
- These sensors are available through an API on the phone
- Commercial location demand is driving implementation
- These sensors report in Pressure Altitude. This may be the most useful form of altitude for public safety. It can show an accurate difference in altitude between the first responder and the emergency caller (i.e. The emergency caller is 30' above me)
- Challenges with other forms of altitude:
 - Mean Sea Level (MSL) Altitude (PA adjusted for local temp and pressure)
 - Requires a local sensor to provide a current value
 - Above Ground Level (AGL) (MSL adjusted to actual surveyed ground elevation)
 - Floor (AGL adjusted to surveyed height of each floor)

Commercial Handset Based Location

- Why can Starbucks locate me but 9-1-1 can not!
- Commercial location uses additional technologies beyond Cell and GPS
 - WiFi
 - Beacons
 - Barometer
- 9-1-1 could leverage commercial to improve indoor X/Y/Z location
- Very low cost
- Could use API built into smart phones today
- Provides 9-1-1 access to new location technologies as they are deployed for commercial location purposes.
- 9-1-1 location could be used to verify commercial location is not spoofed
- Commercial location technology will probably always be ahead of 9-1-1 location technology
- Could be deployed initially as application (with limitations) then integrated into handset through standards.



9-1-1 Specific Location Technology

- New location technologies developed for 9-1-1
- NextNav demonstrated technology in San Francisco
- Very expensive
- Marginal increase in accuracy for major metro indoor locations. Still not enough to reliably find the door the caller is behind in urban locations.
- Provides X / Y / Z / Uncertainty

PSAP Changes needed

- Simplify and add consistency to what is sent to a PSAP.
 - Pass X / Y / Uncertainty and Dispatchable address
 - Pass X / Y / Uncertainty
- Set confidence to industry standard value of 90%
- Differentiation between Phase 1 and Phase 2 to determine location accuracy no longer makes sense. Pass X / Y / Uncertainty
- Need to enhance systems to understand Z

Questions

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